Summary of Activities in 2005-06 and Plans for 2006-2007

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Outline

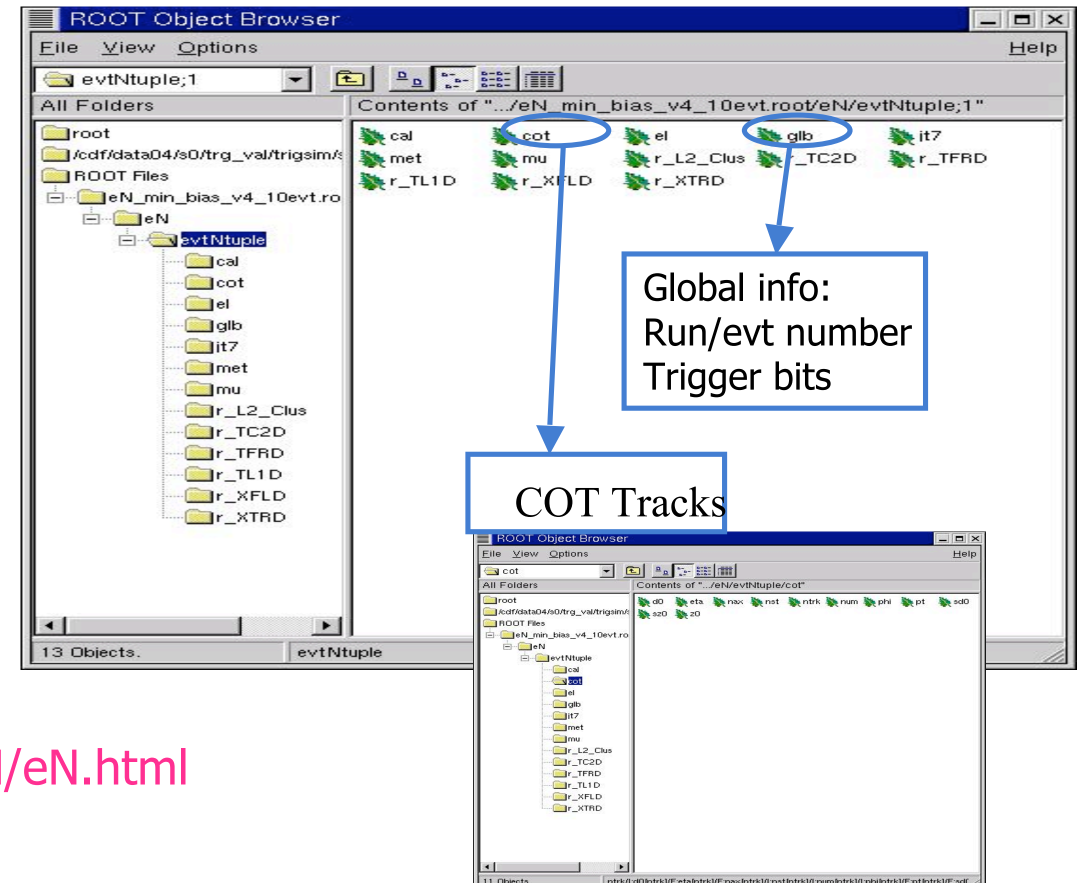
- CDF activities
  - Service work
  - Physics analysis
    - Search for LeptoQuarks: 1st and 2nd generation
    - Search for LeptoQuarks: 3rd generation
    - Search for quark substructure in dijet events
- ATLAS
  - Physics Analysis:
    - Leptoquarks
    - Single Top
    - CSC Notes
- Miscellanea (talks and presentations)

Service work at CDF

CDF eventNutple - eN

Event information is translated into ROOT branches:

- **High Level Objects**
- **Trigger Information**
- **Raw Data Information**
- **Simulated information**



eN is one of the three main analysis tools used in CDF

http://ncdf70.fnal.gov:8001/talks/eN/eN.html

Service work at CDF (cont'd)

TRGSim++ Coordinator

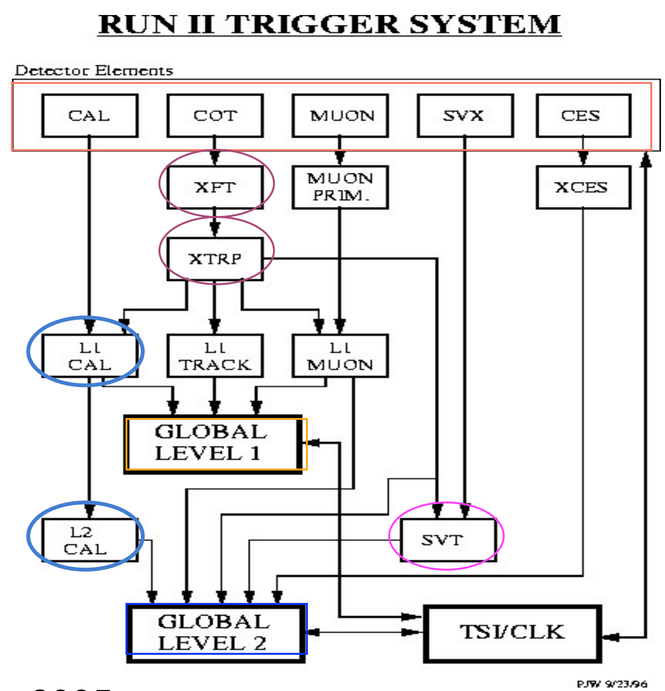
set of (C++) packages which emulate the various trigger levels decision steps (CDF trigger is fully digital)

- offline tool to calculate rates and efficiencies;
- online monitoring tool.

TRGSim++ modules run off detector raw data and produce emulated trigger data identical to real hardware data.

Trigger decision steps: A_C++ modules, organized in packages:

- CalTrigger
- MuonTrigger
- XFTSim
- SVTSim
- XTRPSim
- L2/L1GlobalTrigger
- TriggerMods
- TriggerObjects



http://ncdf70.fnal.gov:8001/trigsim/trgsim.html

Service Work at CDF (cont'd)

Id and Physics Performance Coordinator

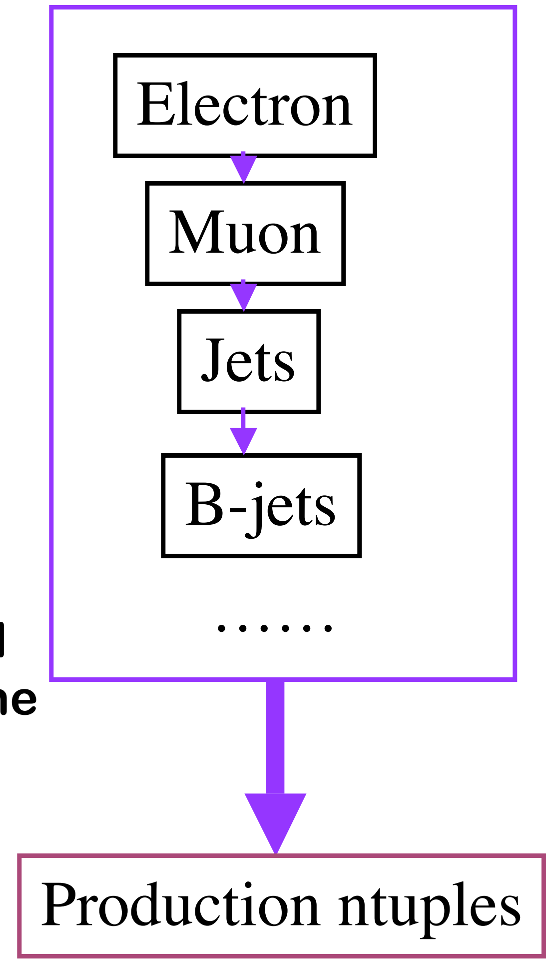
The idea is to have much of analysis infrastructure at CDF automatized to guarantee smooth running in the next two years

Some aspects of all analyses are in common:

- lepton ID efficiency, reconstruction,trigger
- Jet Energy corrections
- B-tagging Scale factors
- tau reconstruction
- ……

The task is to provide a common software framework which will incorporate all the relevant piece of code and will output a lookup table/webpage/documentation on the values of different parameters for different run ranges.

First implementation expected for March 2007 Winter Conferences



LeptoQuarks

- **Leptoquarks (LQ)** are hypothetical particles which appear in many SM extensions to explain **symmetry between leptons and quarks**
  - SU(5) GUT model
  - superstring-inspired models
  - 'colour' SU(4) Pati-Salam model
  - composite models
  - technicolor

•LQs are **coupled to both leptons and quarks** and carry SU(3) color, fractional electric charge, baryon (B) and lepton (L) numbers

•**LQs can have**:

–spin 0 (scalar)

•couplings fixed, i.e., no free parameters

•Isotropic decay

–spin 1 (vector)

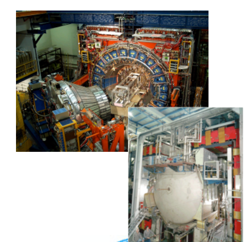
•anomalous magnetic (k_G) and electric quadrupole (λ_G) model-dependent couplings

–Yang-Mills coupling: $k_G = \lambda_G = 0$

–Minimal coupling: $K_G = 1$, $\lambda_G = 0$

–Decay amplitude proportional to $(1 + \cos\theta^*)^2$

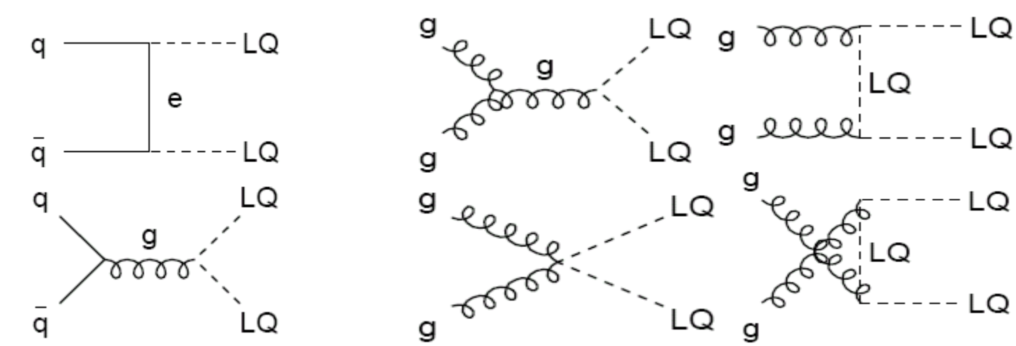
- **Experimental evidence searched:**
  - indirectly: LQ-induced 4-fermion interactions
  - directly: production cross sections at collider experiments



LQ at Hadron Colliders

- **Pair production**
  - Practically independent of Yukawa coupling λ (only g-LQ-LQ vertex)
  - Depends mainly on LQ mass

$q\bar{q} \rightarrow LQ\ LQ$ $\quad$ $gg \rightarrow LQ\ LQ$



Decay

- Each generation can decay into 3 final states: $\beta = Br(LQ \rightarrow lq)$

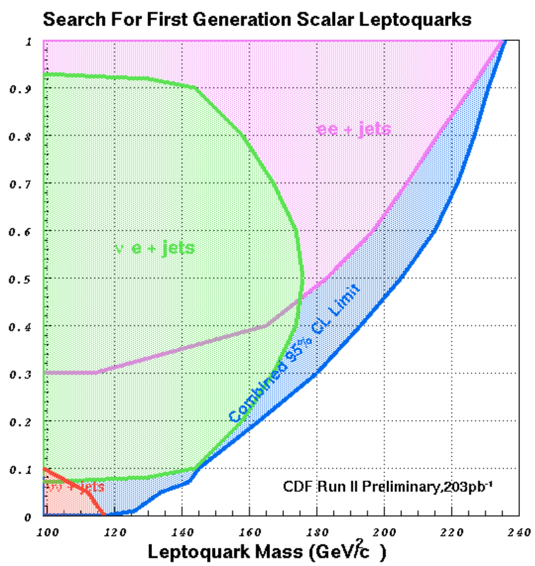
Exclusive to the Tevatron

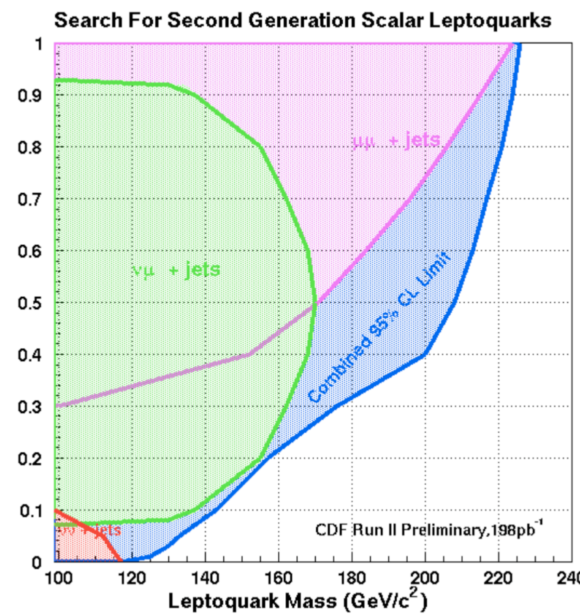
	1^{st} Generation	2^{nd} Generation	3^{rd} Generation
$\beta = 1$	$LQ\ \overline{LQ} \rightarrow e^- e^+ q\bar{q}$	$LQ\ \overline{LQ} \rightarrow \mu^+ \mu^- q\bar{q}$	$LQ\ \overline{LQ} \rightarrow \tau^+ \tau^- q\bar{q}$
$\beta = 0.5$	$LQ\ \overline{LQ} \rightarrow e^\pm \nu_e q_i q_j$	$LQ\ \overline{LQ} \rightarrow \mu^\pm \nu_\mu q_i q_j$	$LQ\ \overline{LQ} \rightarrow \tau^\pm \nu\, q_i q_j$
$\beta = 0$	$LQ\ \overline{LQ} \rightarrow \nu_e \nu_e q\bar{q}$	$LQ\ \overline{LQ} \rightarrow \nu_\mu \nu_\mu q\bar{q}$	$LQ\ \overline{LQ} \rightarrow \nu_\tau \nu_\tau q\bar{q}$

LQ at CDF

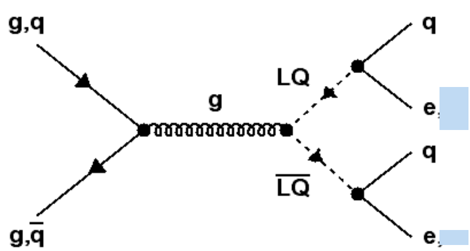
Tufts is the primary institutions doing LQ searches in RunII:

- 1st generation, eeqq, eνqq + combined result (Simona)
- 2nd generation:$\mu\mu$qq,$\mu\nu$qq + combined result (Dan-Simona)
- 3rd generation:$\tau\tau$qq (Hao, Simona,Chris)



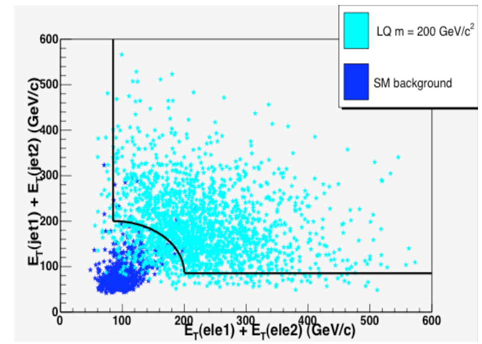


Search for LQ in dileptons + jets (I)



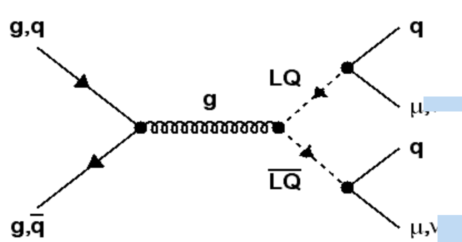
Selection

- ✓ 2 electrons (CC,CF) $E_T > 25$ GeV
- ✓ 2 jets, $E_T(j1) > 30$ GeV, $E_T(j2) > 15$ GeV
- ✓ Z Veto ($76 < M_{\mu\mu} < 110$) GeV
- ✓ **Electrons/Jets: $E_T^{j1(e1)} + E_T^{j2(e2)} > 85$ GeV**
- ✓ **$((E_T(j_1) + E_T(j_2))^2 + (E_T(e_1) + E_T(e_2))^2)^{1/2} > 200$ GeV**



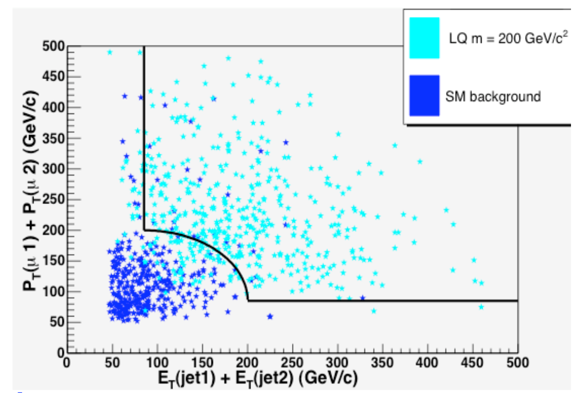
SM background

- ➢ Drell-Yan+2jets
- ➢ Top ($W \rightarrow e\nu$)
- ➢ QCD/Fakes

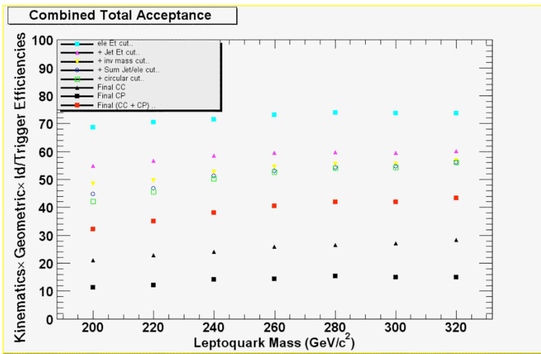


Selection

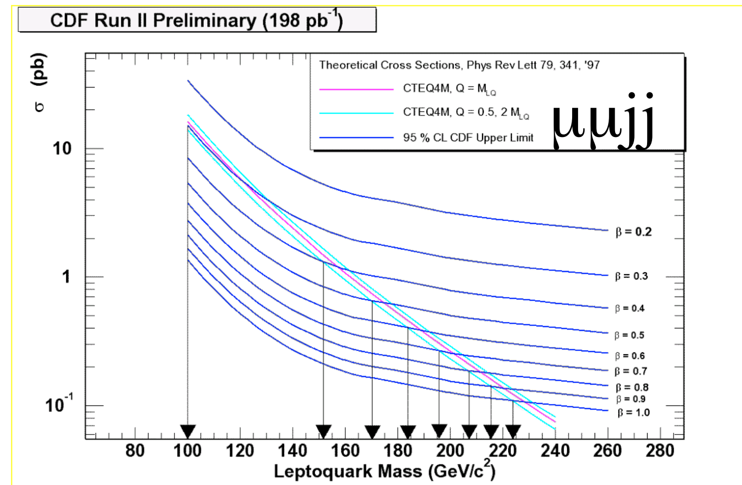
- ❖ 2 muons with $P_T > 25$ GeV
- ❖ 2 jets with $E_T(j1,j2) > 30,15$ GeV
- ❖ Dimuon Mass Veto:
  - ❖ $76 < M_{\mu\mu} < 110$, $M_{\mu\mu} < 15$ GeV
- ❖ $E_T(j_1) + E_T(j_2) > 85$ GeV and $P_T(\mu_1) + P_T(\mu_2) > 85$ GeV
- ❖ $((E_T(j_1) + E_T(j_2))^2 + (P_T(\mu_1) + P_T(\mu_2))^2)^{1/2} > 200$ GeV

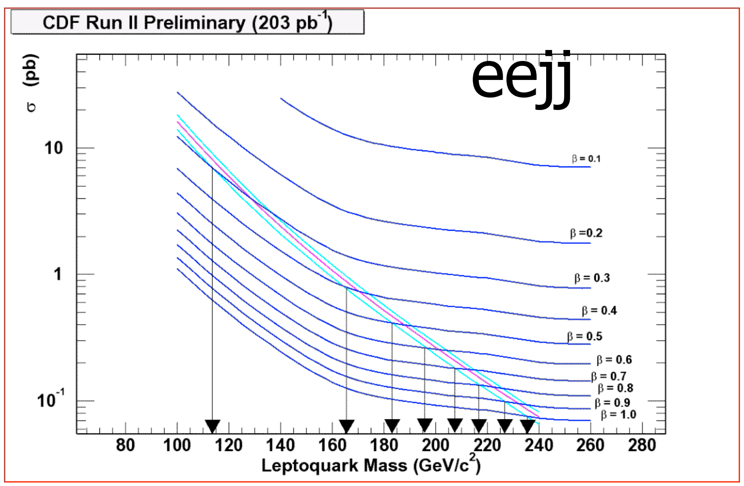


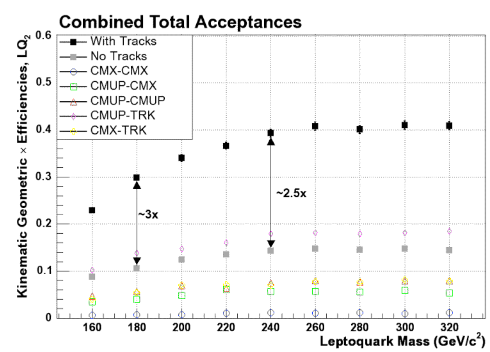
Search for LQ in dileptons + jets (II)



Exclude at 95% CL M_{LQ}<224 GeV/c^2 for β = 1.0

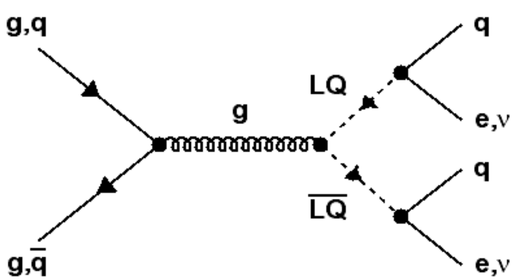






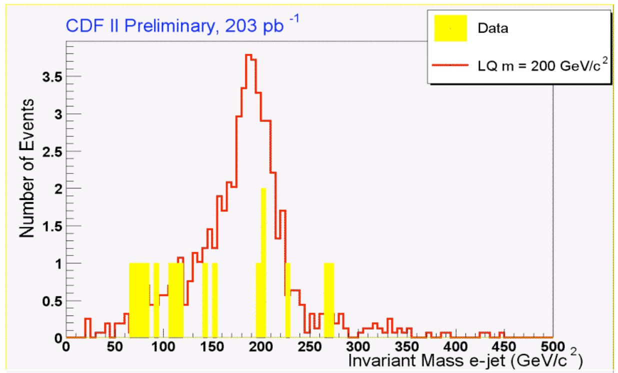
Exclude at 95% CL M_{LQ}<235 GeV/c^2 for β = 1.0

Search for LQ in lepton + MET + jets



Selection

1central electrons with E_T > 25 GeV
MET > 60 GeV
Veto on 2nd electron, central loose or Plug
2 jets with E_T > 30 GeV
$\Delta\phi$ (MET-jet) > 10°
$E_T(j1) + E_T(j2)$ > 80 GeV
$M_T(e\text{-}\nu)$ > 120
LQ mass combinations

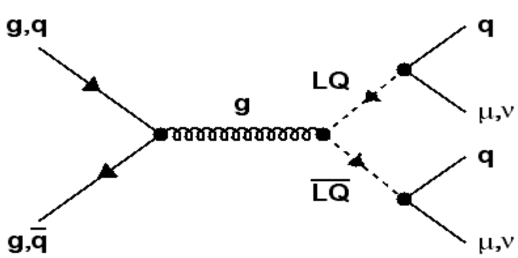


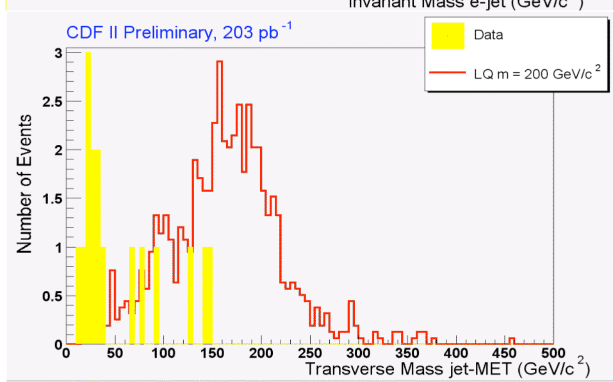
SM background

- W +2jets
- Top (l + jets and dilepton)
- QCD/Fakes

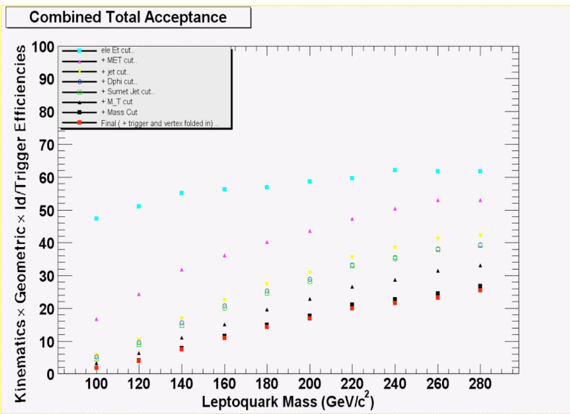
Selection

Z veto (tight/loose pair)
No 2nd muon (CMUP, CMX, or stubless)
$P_T(\mu)$ > 25 GeV
$\not{E}_T$ > 60 GeV
2 jets, @ E_T>30GeV
$\Delta\phi(\mu,\not{E}_T)$<175°, $\Delta\phi(\not{E}_T,\text{jets})$>5°
$E_T(\text{jet1})+E_T(\text{jet2})$ > 80 GeV
$M_T(\not{E}_T,\text{Muon})$ > 120 GeV/c²
Mass Cut

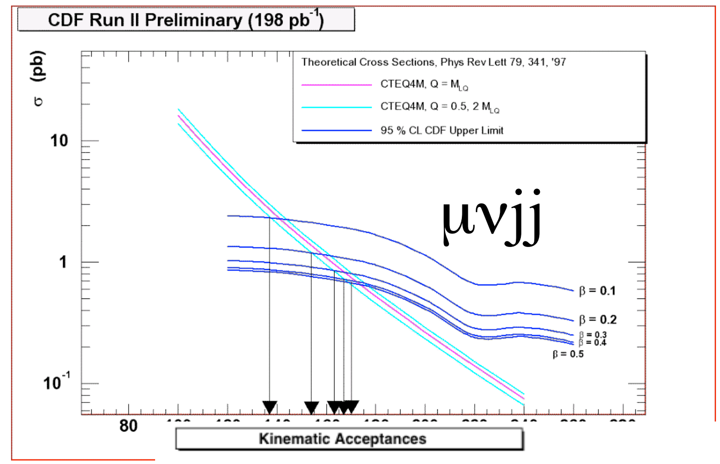


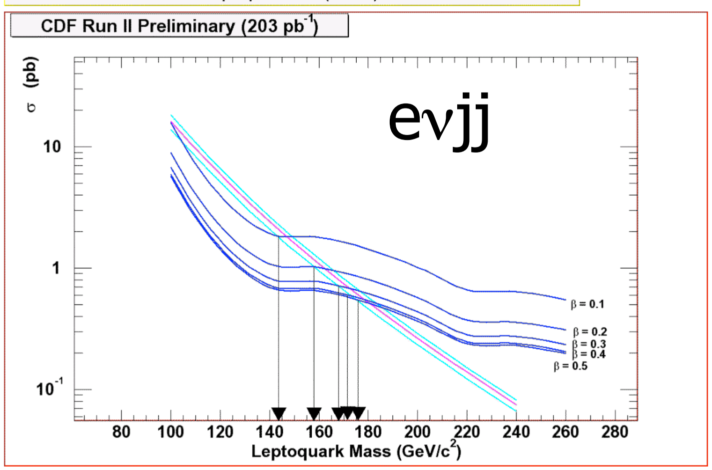


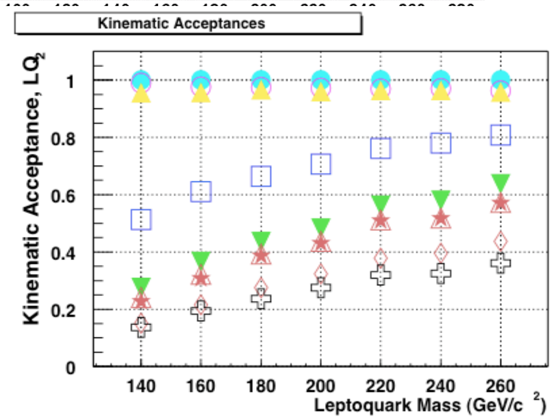
Search for LQ in lepton,MET + jets (II)



Exclude at 95% CL M_{LQ}<170 GeV/c^2 for β = 0.5







Exclude at 95% CL M_{LQ}<176 GeV/c^2 for β = 0.5

Combined Limits

Joint likelihood formed from the product of the individual channels likelihood.
The searches in the dileptons and lepton + MET channels use common criteria and sometime apply the same kind of requirements (for example on lepton identification) so the uncertainties in the acceptances have been considered completely correlated (which gives the most conservative limit).
When calculating the limit combination including also the $\nu\nu jj$ channel the uncertainties in the acceptances have been considered uncorrelated.A correlation factor of 0.5 has also been considered (no difference)

$$\sigma_{LIM} = N_{LIM}/(\varepsilon_{average} \times \mathcal{L})$$

$\varepsilon_{average} = (\beta^2\varepsilon(eejj) + 2\beta(1-\beta)\varepsilon(e\nu jj) + \beta^2\varepsilon(ee \text{ as } e\nu))$ for the 2 channels case and
$\varepsilon_{average} = (\beta^2\varepsilon(eejj) + 2\beta(1-\beta)\varepsilon(e\nu jj) + (1-\beta)^2\varepsilon(\nu\nu jj) + \beta^2\varepsilon(ee \text{ as } e\nu))$ for the 3 channels case.

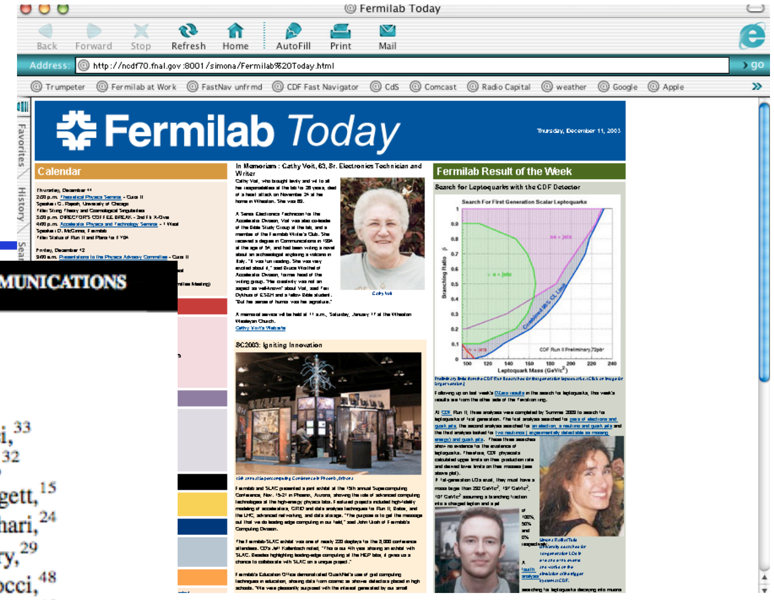
TABLE III: 95% C.L. lower limits on the first generation scalar leptoquark mass (in GeV/c^2), as a function of β.The limit from CDF[7] ($eejj$) Run I ($\sim 120 pb^{-1}$) is also given.

β	ee jj	$e\nu jj$	$\nu\nu jj$	Combined	CDF Run I
0.01	-	-	116	126	-
0.05	-	-	112	134	-
0.1	-	144	-	145	-
0.2	-	158	-	163	-
0.3	114	167	-	180	-
0.4	165	174	-	193	-
0.5	183	176	-	205	-
0.6	197	174	-	215	-
0.7	207	167	-	222	-
0.8	216	158	-	227	-
0.9	226	144	-	231	-
1.0	235	-	-	236	213

TABLE III: 95% C.L. lower limits on the second generation scalar leptoquark mass (in GeV/c^2), as a function of β.The limit from CDF[4] ($\mu\mu jj$) Run I ($\sim 120 pb^{-1}$) is also given.

β	$\mu\mu$ jj	$\mu\nu jj$	$\nu\nu jj$	Combined	CDF Run I
0.01	-	-	114	125	-
0.05	-	-	110	133	-
0.1	-	137	-	143	-
0.2	-	155	-	157	-
0.3	100	162	-	176	-
0.4	152	168	-	200	-
0.5	171	170	-	208	-
0.6	184	168	-	213	-
0.7	196	162	-	217	-
0.8	206	155	-	221	-
0.9	215	137	-	224	-
1.0	224	-	-	226	202

Publications



RAPID COMMUNICATIONS

PHYSICAL REVIEW D **72**, 051107(R) (2005)

Search for first-generation scalar leptoquarks in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV

D. Acosta,[16] J. Adelman,[12] T. Affolder,[9] T. Akimoto,[54] M. G. Albrow,[15] D. Ambrose,[15] S. Amerio,[42] D. Amidei,[33] A. Anastassov,[50] K. Anikeev,[15] A. Annovi,[44] J. Antos,[1] M. Aoki,[54] G. Apollinari,[15] T. Arisawa,[56] J-F. Arguin,[32] A. Artikov,[13] W. Ashmanskas,[15] A. Attal,[7] F. Azfar,[41] P. Azzi-Bacchetta,[42] N. Bacchetta,[42] H. Bachacou,[28] W. Badgett,[15] A. Barbaro-Galtieri,[28] G. J. Barker,[25] V. E. Barnes,[46] B. A. Barnett,[24] S. Baroiant,[6] G. Bauer,[31] F. Bedeschi,[44] S. Behari,[24] S. Belforte,[53] G. Bellettini,[44] J. Bellinger,[58] A. Belloni,[31] E. Ben-Haim,[15] D. Benjamin,[14] A. Beretvas,[15] T. Berry,[29] A. Bhatti,[48] M. Binkley,[15] D. Bisello,[42] M. Bishai,[15] R. E. Blair,[2] C. Blocker,[5] K. Bloom,[33] B. Blumenfeld,[24] A. Bocci,[48] A. Bodek,[47] G. Bolla,[46] A. Bolshov,[31] D. Bortoletto,[46] J. Boudreau,[45] S. Bourov,[15] B. Brau,[9] C. Bromberg,[34] E. Brubaker,[12] J. Budagov,[13] H. S. Budd,[47] K. Burkett,[15] G. Busetto,[42] P. Bussey,[19] K. L. Byrum,[2] S. Cabrera,[14] M. Campanelli,[18] M. Campbell,[33] F. Canelli,[7] A. Canepa,[46] M. Casarsa,[53] D. Carlsmith,[58] R. Carosi,[44] S. Carron,[14] M. Cavalli-Sforza,[3] A. Castro,[4] P. Catastini,[44] D. Cauz,[53] A. Cerri,[28] L. Cerrito,[41] J. Chapman,[33] Y. C. Chen,[1] M. Chertok,[6] G. Chiarelli,[44] G. Chlachidze,[13] F. Chlebana,[15] I. Cho,[27] K. Cho,[27] D. Chokheli,[13] J. P. Chou,[20] S. Chuang,[58] K. Chung,[11] W-H. Chung,[58] Y. S. Chung,[47] M. Cijliak,[44] C. I. Ciobanu,[23] M. A. Ciocci,[44] A. G. Clark,[18] D. Clark,[5] M. Coca,[14] A. Connolly,[28] M. Convery,[48] J. Conway,[6] B. Cooper,[30] K. Copic,[33] M. Cordelli,[17] G. Cortiana,[42] J. Cranshaw,[52] J. Cuevas,[10] A. Cruz,[16]

RAPID COMMUNICATIONS

PHYSICAL REVIEW D **73**, 051102(R) (2006)

Search for second-generation scalar leptoquarks in $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV

A. Abulencia,[23] D. Acosta,[17] J. Adelman,[13] T. Affolder,[10] T. Akimoto,[54] M. G. Albrow,[16] D. Ambrose,[16] S. Amerio,[42] D. Amidei,[33] A. Anastassov,[51] K. Anikeev,[16] A. Annovi,[45] J. Antos,[1] M. Aoki,[54] G. Apollinari,[16] J.-F. Arguin,[32] T. Arisawa,[56] A. Artikov,[14] W. Ashmanskas,[16] A. Attal,[8] F. Azfar,[41] P. Azzi-Bacchetta,[42] P. Azzurri,[45] N. Bacchetta,[42] H. Bachacou,[28] W. Badgett,[16] A. Barbaro-Galtieri,[28] V. E. Barnes,[47] B. A. Barnett,[24] S. Baroiant,[7] V. Bartsch,[30] G. Bauer,[31] F. Bedeschi,[45] S. Behari,[24] S. Belforte,[53] G. Bellettini,[45] J. Bellinger,[58] A. Belloni,[31] E. Ben Haim,[43] D. Benjamin,[15] A. Beretvas,[16] J. Beringer,[28] T. Berry,[29] A. Bhatti,[49] M. Binkley,[16] D. Bisello,[42] M. Bishai,[16] R. E. Blair,[2] C. Blocker,[6] K. Bloom,[33] B. Blumenfeld,[24] A. Bocci,[49] A. Bodek,[48] V. Boisvert,[48] G. Bolla,[47] A. Bolshov,[31] D. Bortoletto,[47]

At the End of TeVatron Run II

Assumptions:

Same acceptances as now

Number of events observed = number of predicted background

Same errors

β= 1 mass limit up to 250-300 GeV/c^2

β = 0.5 mass limit up to 230-280 GeV/c^2

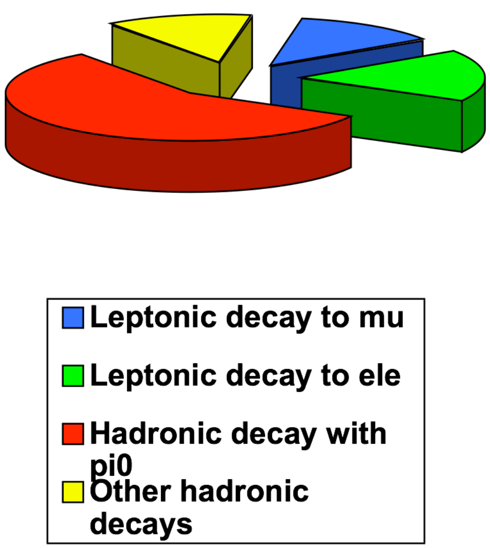
Preliminary

Phys.Rev.D71:057503,2005

New analysis strategy
(not counting experiment anymore?)
might be necessary.......

LQ:Current Activity and Plans

- Third generation LQ's
  - LQ→τb
  - Leptonic decay of both taus will be considered first
    - Lower BR but cleaner signature (high P_T) lepton triggers



- Hadronic ~65%
- Leptonic ~35%
  - $\tau \to e$ 17.84%
  - $\tau \to \mu$ 17.36%

See Hao's talk

Search for Quark Substructure in Dijet Events

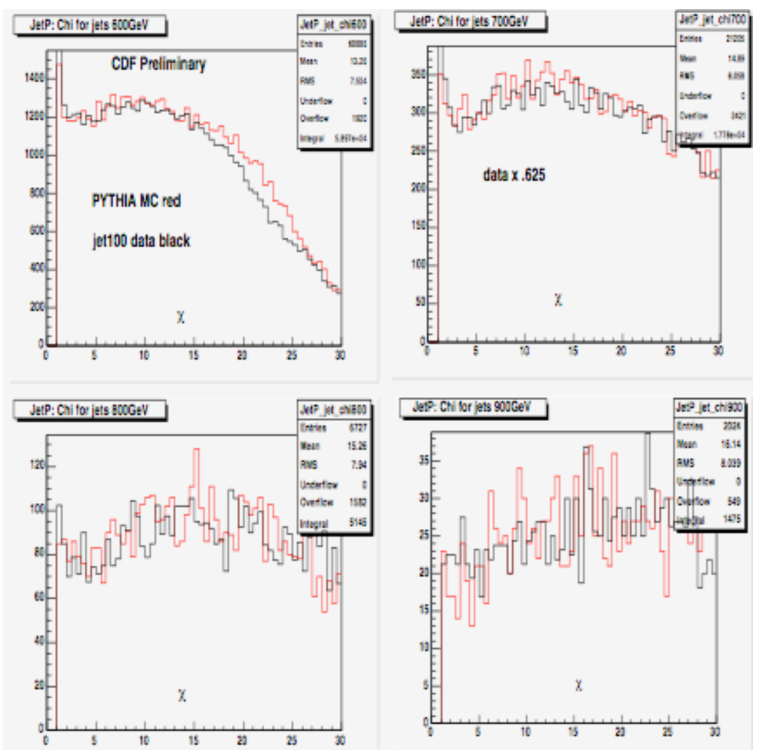
Analysis started by UWM group (L.Pondrom and Y. Shon)

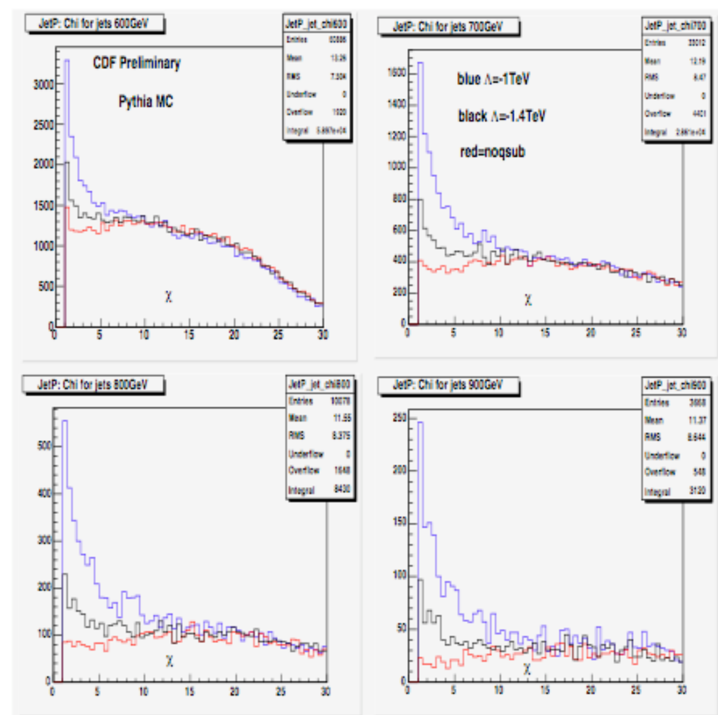
<u>Shape analysis</u>

- comparison of dijet angular distribution to two hypothesis:

<u>SM QCD production</u>

<u>BSM interactions due to quark substructure</u>

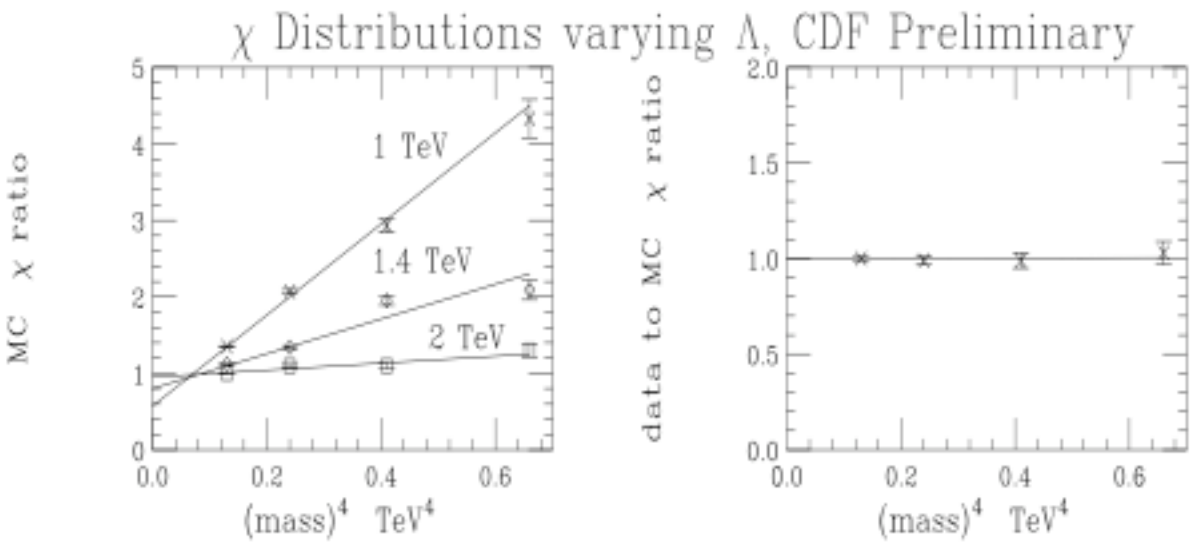




Procedure to extract a limit on Λ

Ratio of MC(Λ)/MC(SM) is plotted vs mass

The same ratio is taken for data/MC(SM)



The data slope is compared to the plot of MC slopes as a function of 1/Λ^4 to determine a bound on Λ.
Current limit is set at Λ > 3.9 TeV at 90% C.L.

Issues with the analysis and Plans

No systematic effects have been considered so far :

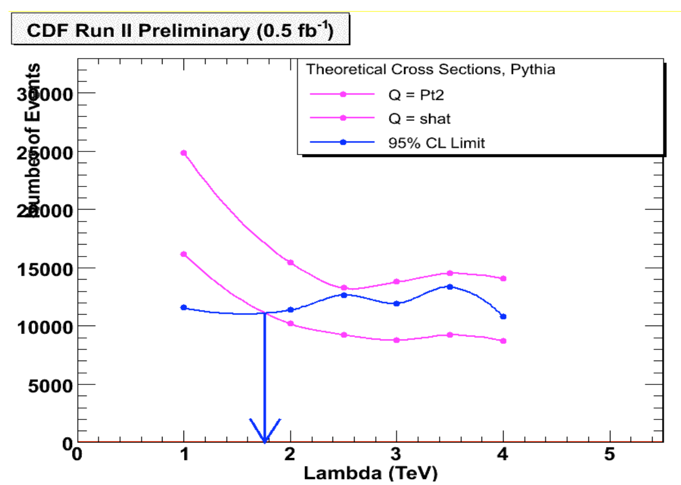
- -scale choice for MC predictions (LO QCD calculation, phenomenological model for quark substructure)
- -jet energy corrections systematics
- -pdf's choice
- -other

New approach to the analysis (Simona):

- -consider it as a counting experiment
- -derive acceptances for dijet events (mass intervals)
- -derive systematic uncertainties as difference in acceptances

Preliminary results lower the limit to $\Lambda > 2.0$ -3 TeV

1fb^{-1} of data available
Reconcile UWM's and Simona's analyses
Push for publication by end of 2007



Physics at LHC

- Les Houches 2005

• Fourth in a series whose aim is to bring together theorists and experimentalists working on the phenomenology of the upcoming TeV colliders .
• The emphasis will be on the physics of the LHC during its first few years of running
  • Strong interplay between:
    • what has been learned from the TeVatron
    • how the next linear collider could complement LHC measurements/findings
  • The impact of cosmology and astrophysics will be addressed.
  • Two WG - convener of BSM

The projects are to start in January 2005 and should be completed by the end of the year 2005.

- TeV4LHC Workshop

Phys.Rev.D71:057503,2005

• Bringing together the Tevatron and LHC experimental groups and the theoretical community to make the best possible use of data and experience from the Tevatron in preparing for the LHC experimental program:
  • Understanding how to use Tevatron data to improve event modelling
  • Theoretical understanding of cross sections for the signals and backgrounds at LHC,
  • Using experience with real problems at the Tevatron

- INFN MC Workshop, Frascati February-November 2006

bringing together exps and theorists to address MC issues at LHC
4 WG - convener of Parton Shower and MC interfaces

Physics Analysis at ATLAS

Two areas of interest:
Exotics Group: LQ search sensitivity
Top Group: Single Top

Collaboration with:
Columbia (LQ)
Udine (SingleTop)

Work started in the framework
of the Rome Physics Workshop (June 2005)
and extended to specific studies aimed at publishing
a Scientific Note on Single Top at ATLAS in 2006-07

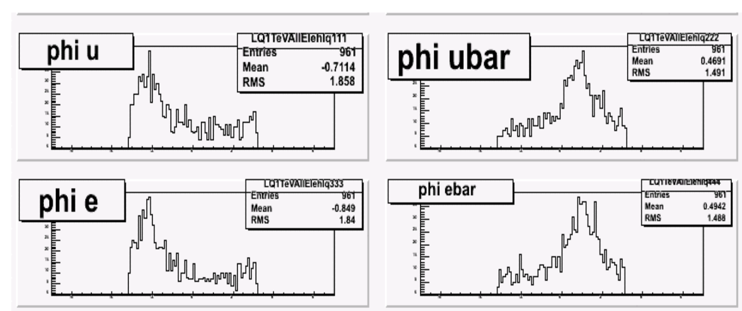
Leptoquarks in ATLAS

LQ sensitivity will extend at LHC to masses up to 1.5 TeV/c^2
Pair production is still the dominant process contributing to the cross section.

In the framework of the Rome workshop, we studied the signal

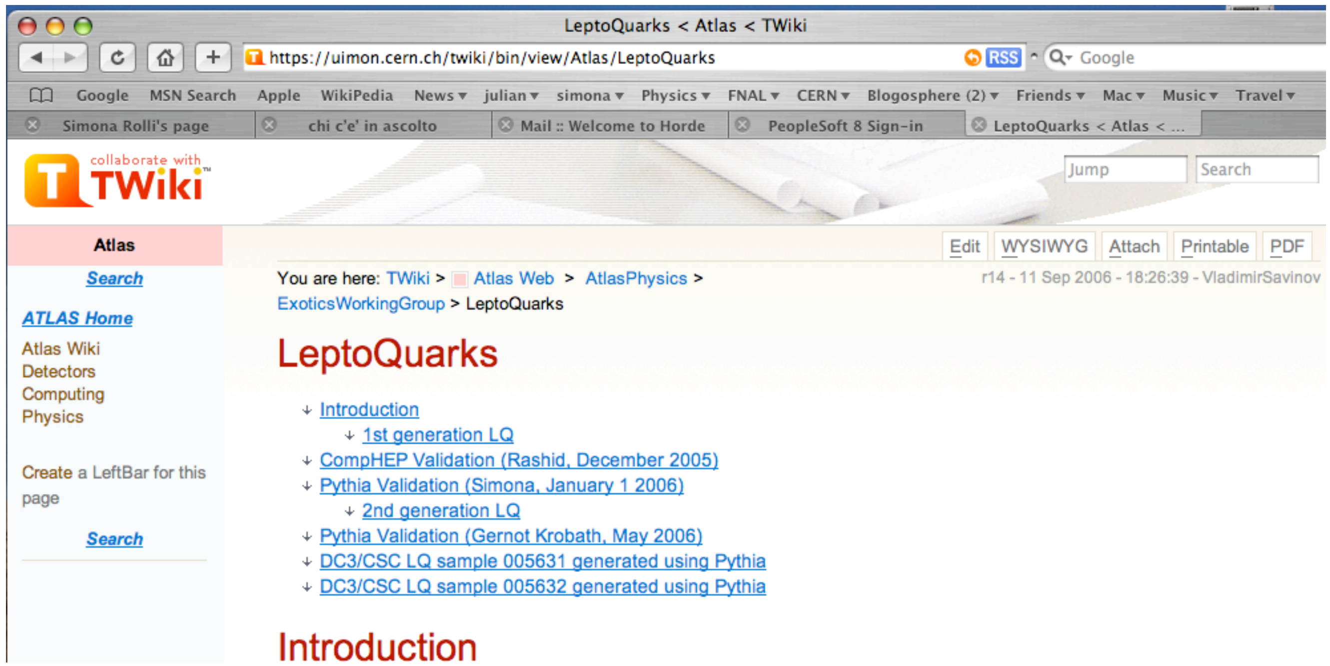
- -Detection efficiency for 2 set of masses, 0.5 TeV and 1 TeV
- -The samples were suffering from a generation problem, but very preliminary results could be derived.
- -The signal efficiency found is in agreement with previous measurement performed in the framework of the fast ATLAS simulation

Generator Level ϕ distribution



Current Status

New MC samples have been generated: initial samples have been validated and checked



Scientific Note on BSM in final states containing dileptons and jets is in progress

Interested in exploring sensitivity to LQ possible discovery

Expected Sensitivity for 100pb^{-1} and 1fb^{-1}

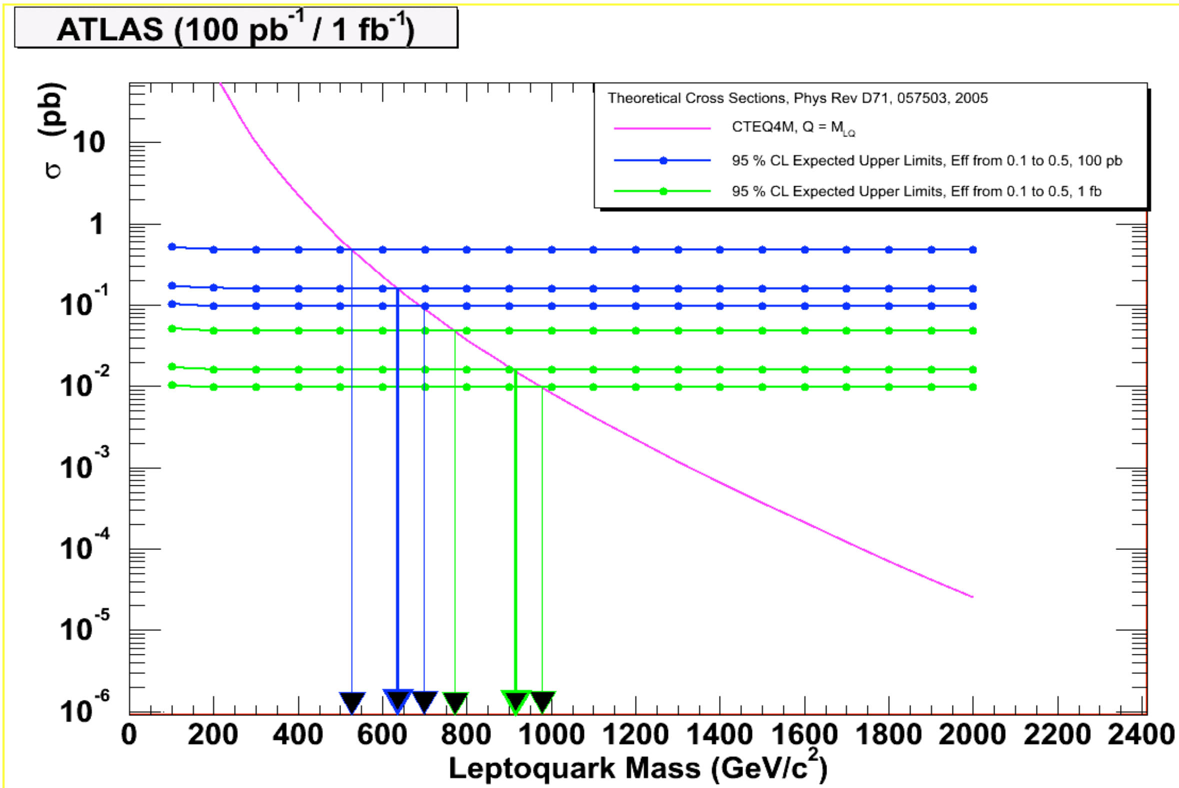
1) the cross section is the NLO recent calculation from M. Spira et al. (Phys.Rev.D71, 057503, 2005) for LQ pair production

2) the signal efficiency is assumed to vary from 0.10 to 0.50 for all masses (going from 100, already excluded, to 2000 GeV/c^2)
This would the final efficiency, which will include lepton ID, trigger, kinematical/topological cuts.
a) Remember that, from TeVatron/HERA results, the region of interest with a few pb will be m(LQ) > 300 GeV/c^2
b) the number for the signal efficiency from the old study from Mitsou et al. is about 0.60, so I used that as an upper limit.

3) in the calculation of the expected σ_{limit} (95% CL) I had to make some assumptions on the number of observed and expected events. I used a S/B ratio going from 10 to 100 (again roughly using the numbers quoted in Vienna 2004) and the limit varies of a factor of 2, which effect when crossing the steeply falling theory cross section is negligible.

The "limit" is calculated in the assumption of seeing 0 signal, ie number of events observed = number of expected background events (and background subtraction if the number of observed evts is not 0). So this is really the best scenario. Of course any (limited) excess will lower the mass limit, but of course at some point it will show the new physics...

Projected sensitivity



<u>Conclusion</u>

for 100pb^{-1} we could be able to set limits up to 700 GeV/c^2
for 1fb^{-1} slightly less than 1TeV.

Single Top in ATLAS

First Look at single-top cross-section measurements in Atlas with FullSim AOD's

Arnaud Lucotte

IN2P3/LPSC Grenoble

Thanks To :

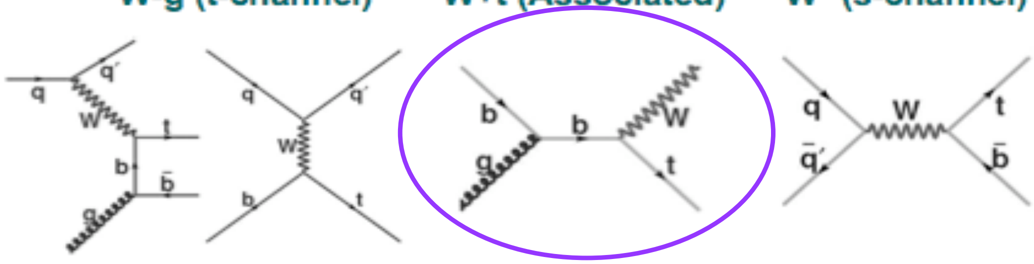
Within the Top Group :
- F. Chevallier (LPSC)
- M. Barisonzi (NiKHEF)
- M. Cobal, M.P. Giordani (Udine)
- S. Rolli (Tufts)
- C. Roda, I. Vivarelli (Pisa)

The Athena/PhysicsAnalysis/ Experts :
- K. Assamagan (BNL)
- S. Binet (Clermont-Ferrand)
- Production team, etc...

Single-top in the SM

- 3 production mechanisms

W-g (t-channel) W+t (Associated) W* (s-channel)



→ Two of them could be seen at theTeVatron (W*,Wg)

→ All will be measured *precisely* at the LHC

Motivations

- Properties of the Wtb vertex :
  - Determination of $\sigma(pp \to tX)$, $\Gamma(t \to Wb)$
  - Direct determination of $|V_{tb}|$
  - Top polarization
- Precision measurements → probe to new physics
  - Anomalous couplings, FCNC → t-channel,W+t
  - Extra gauge-bosons W' (GUT, KK)
  - Extra Higgs boson (2HDM) → s-channel
- Single-top is one of the main background to ...

  ... Higgs physics with jets...

Selection efficiency

ε(%)	W+t FullSim	W+t TDR
Total processed	--	
N(ele)=1, p_T>20	49.5	
p_T(e)>20, mE_T>20	44.3	
N(b-jet) = 1, p_T>50	18,7	
N(jet) = 2, p_T>30	8.98	
60 < m_{jj} < 95	0.93	1.27

M. Cobal, Giordani, Rolli, C. Roda

Initial Studies

- CBNT and AOD preliminary studies performed for Rome workshop (June 2005):
  - Starting point was to reproduce the TDR numbers;
  - Final goal is to complete the analysis with full simulation, all background sources and new analysis tools.

Description of cuts	Cumulative Selection Efficiency (%)		
TDR	Wt	$t\bar{t}$	$Wb\bar{b}$
Pre-selection cuts	25.5	44.4	2.49
njets = 3; $p_T > 50$ GeV	3.41	4.40	0.05
nb-jet = 1	3.32	3.24	0.037
$m_{tot} < 300$ GeV	1.43	0.71	0.008
$65 < m_{jj} < 95$ GeV	1.27	0.41	0.003
Events/30 fb^{-1}	6828 ± 269	30408 ± 742	58 ± 19

CNBT Studies Summary

40000 Wt generated with TopRex

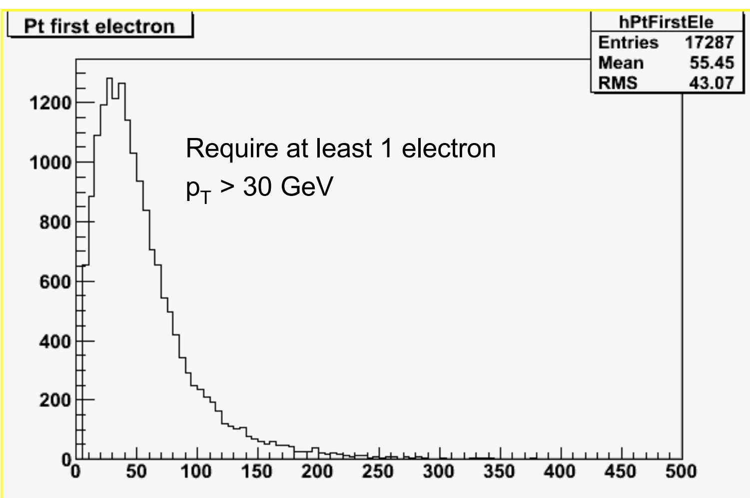
rome.004530.evgen.wt_ph_ml._0000X.pool.root

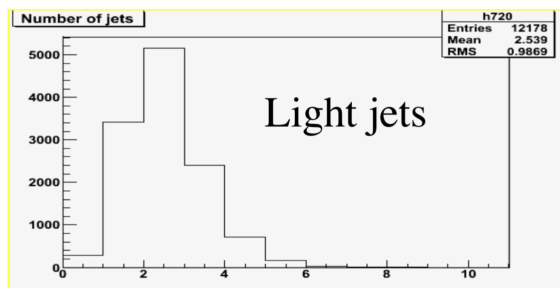
$X=1,9$ $(W^- \rightarrow l^- \upsilon \; W^+ \rightarrow jj)$

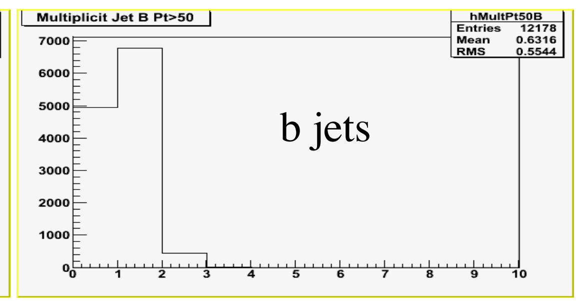
Standard Atlfast run on it, relevant parameters:

Electrons: pt > 5 GeV, $|\eta|<2.5$

Jets: Cone 0.4, pT > 5 GeV



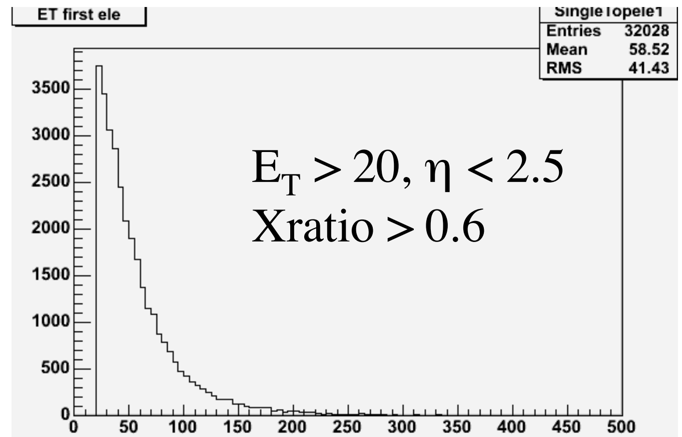




All evts	40000
1 lepton	12178
1 b jets pt 50	6788
2 light jet pt 30	2873 (7.1%)

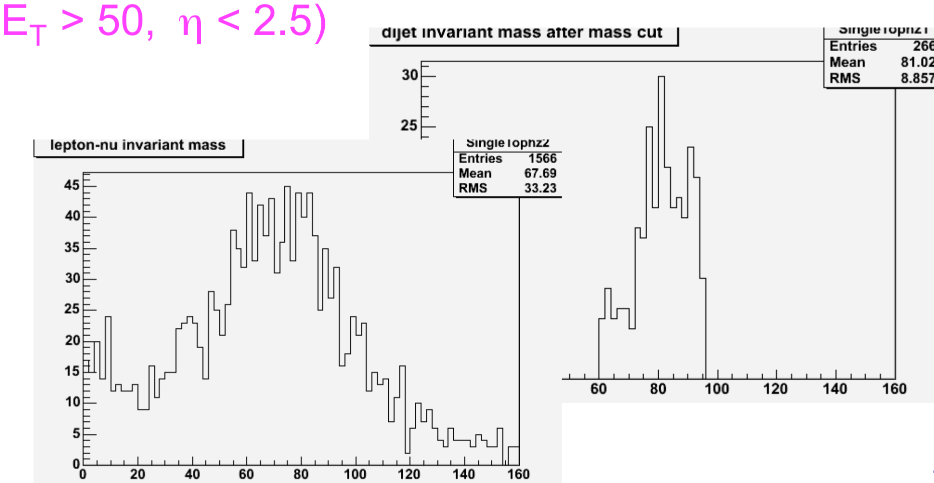
AOD Studies Summary

- 65020 events from rome.004530.recov10.wt_ph_ml.* and rome.004531.recov10.wt_pl_mh.*
- Objects accessed:
  - ElectronCollection
  - METFinal
  - ConeTowerParticleJets (Cone 07)
  - BJetCollection



32028 evts with 1 one P_T ele (XRatio > 0.6)
28582 evts with MET > 20 GeV
12175 evts with 1 and only 1 b-jet (Lhsig > 0.9, E_T > 50, η < 2.5)
1566 evts with 2 jets (3 total) E_T > 30, η < 2.5

<u>2.4% final acceptance (3% TDR)</u>



Goals

VALIDATION:
- We want to arrive to a systematic comparison of CBNT and AOD for fast and full simulation using the Wt channel

To Do List:
-- Ele ID check (IsEM vs Xratio vs Likelihood)
-- B-tagging Efficiency: Standard Algorithms vs Combined Likelihood
-- Adding Muons (an entirely different beast..)
-- Study of jet linearity and energy resolution systematics
-- Full Comparison with TDR and coherence between atlfast and AOD analysis
-- Complete background picture (where are W + jets?)
-- AOB

PHYSICS

-- Benchmark the channel and identify the analysis strategy
-- Understand possible sensitivity to new physics

B-Tagging Studies

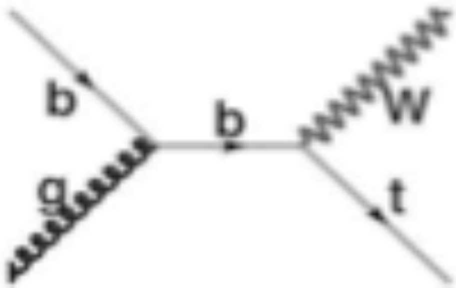
Summary on b-tagging algs

- Historical » taggers:
  - **IP2D**: transverse impact parameter
  - **IP3D**: 2D+longitudinal
  - **SV1, SV2**: inclusive secondary vertex **SV1+IP3D** (we call it FabSV)
- New taggers:
  - Lifetime2D: transverse impact parameter
  - **lhSig**: secondary vertex + impact parameter (2D&3D)
- Tagging weights:
  - For each taggers discriminative variables are selected (iifetime taggers: impact significances $S=d_0/\sigma(d_0)$) and calibration functions are built:
    - Track weight: likelihood ratio $w_t=P_b(S)/P_u(S)$
  - Jet weight: $W_j= \Sigma \ln w_t^i$
- Generalization of the weight for various taggers, can be combined by summing them up (IP3D + SV1).

B-tagging performance estimators

- b-jet efficiency ε_b as function of variable cut:
  - Denominator:
    - jets defined as b using MC truth with p_T> 50 GeV/c, $|\eta|$<2.5
  - Numerator:
    - ditto + cut on a tagging weight
- light-jet rejection $R_u = 1 / \varepsilon_u$
  - R=100 means 1% mistag rate
  - light jets: u, d, s, g

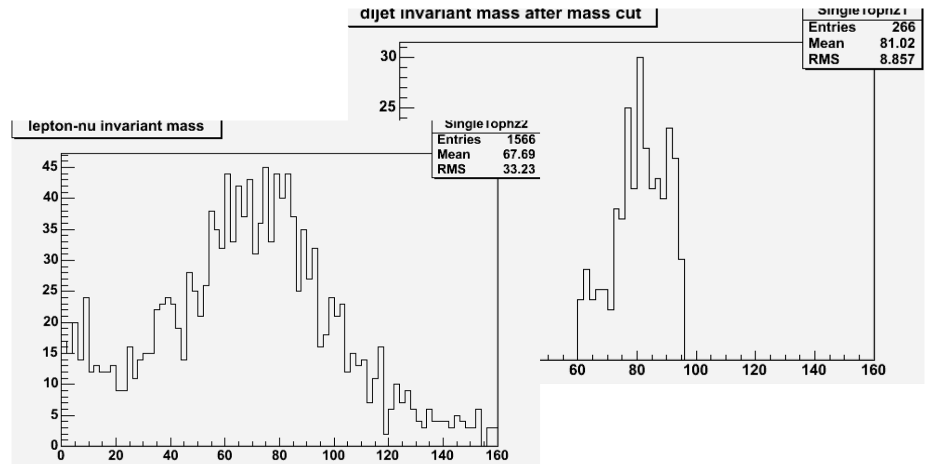
Wt channel



Selection of a specific topology

- Number of high-p_T jets Njet) = 3
- Presence of a high-p_T b-tagged jets
  → Only **one** b-jet in W+t events
- Presence of a W-boson mass peak
  → requires $60 < M(j,j) < 90$ GeV/c^2

1 b-jet
2 light jets



32028 evts with 1 one P_T ele (XRatio > 0.6)
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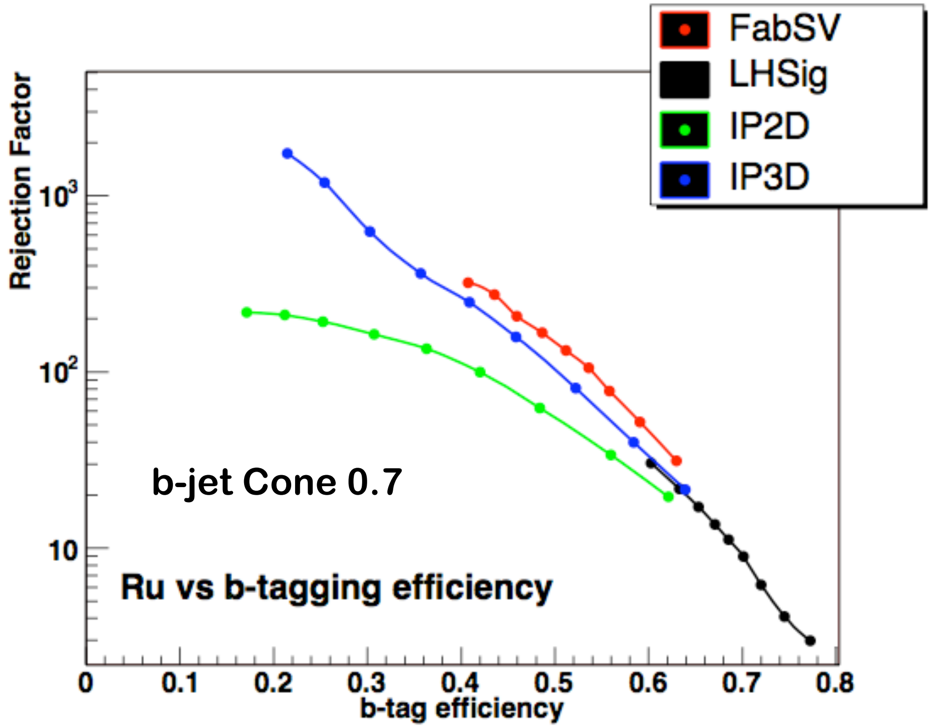
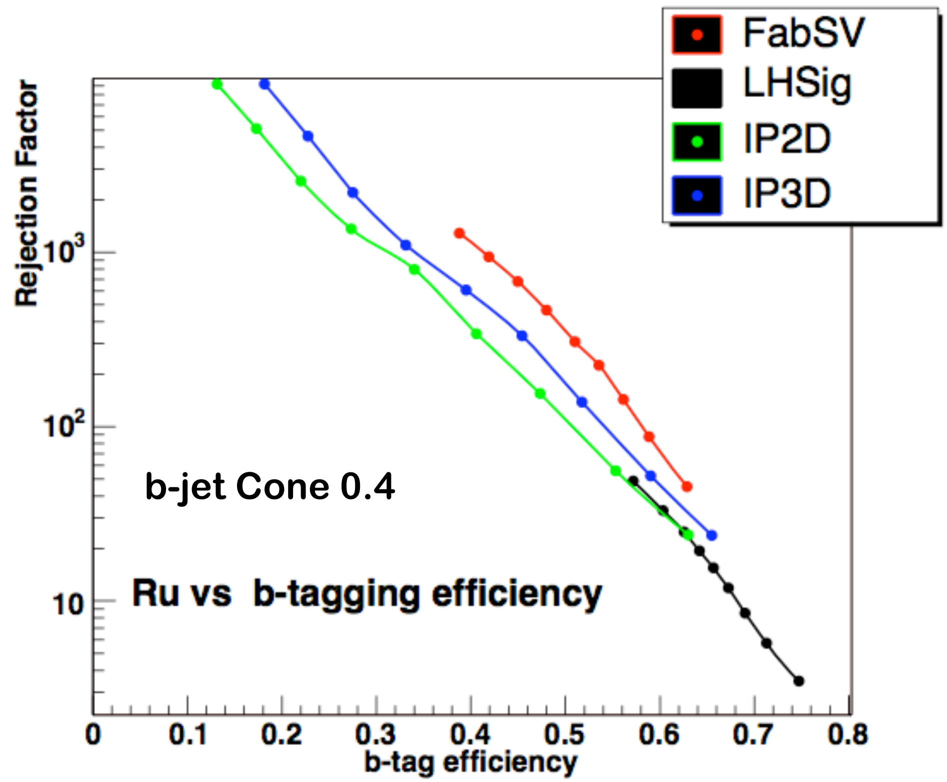
<u>2.4% final acceptance (3% TDR)</u>

Rejections

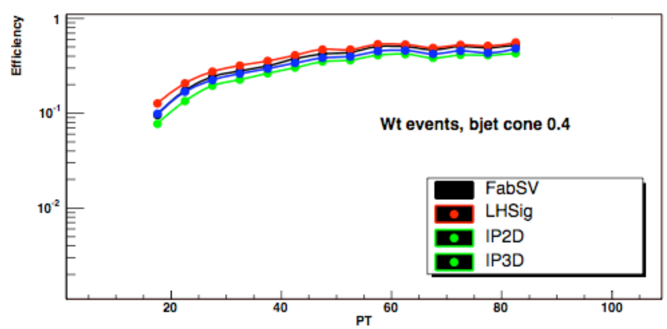

FabSV
LHSig
IP2D
IP3D
Rejection Factor
10^3
10^2
10
b-jet Cone 0.7
Ru vs b-tagging efficiency
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
b-tag efficiency

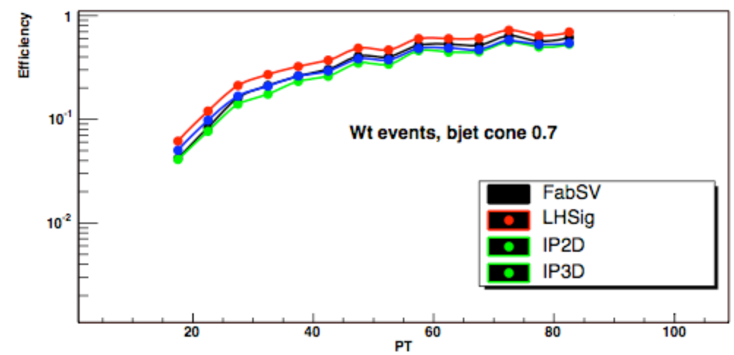

FabSV
LHSig
IP2D
IP3D
Rejection Factor
10^3
10^2
10
b-jet Cone 0.4
Ru vs b-tagging efficiency
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
b-tag efficiency

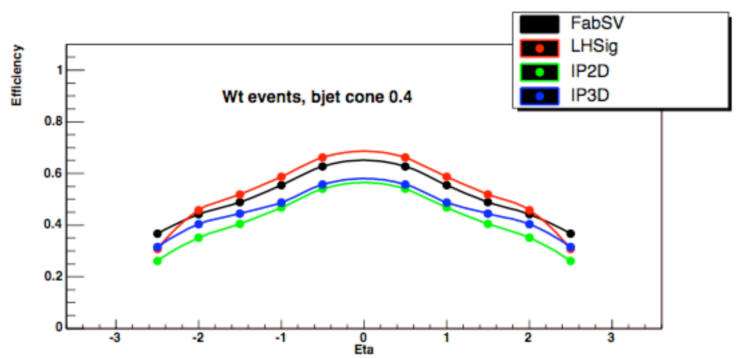
Wt: Efficiencies (P_T and η)

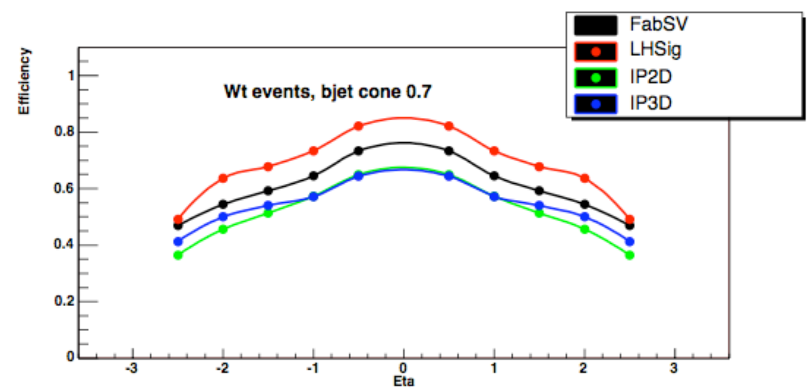
Efficiencies are calculated in the following way:
Denominator: number of b-partons with P_T and η in given interval;
Numerator: bjets matched with the b-parton (parton level info) with P_T and η in given interval and cut on weight/LHSig.

weight/likelihood cut fixed

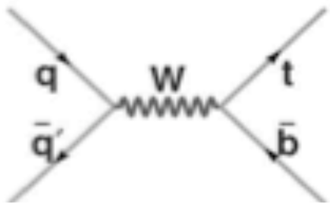








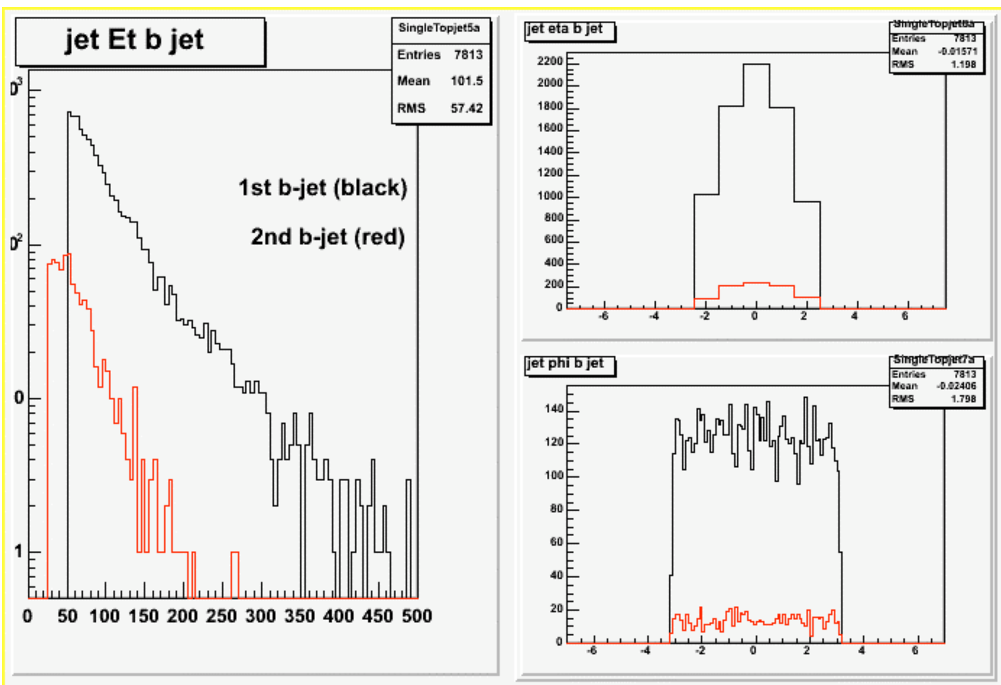
s-channel



Selection criteria

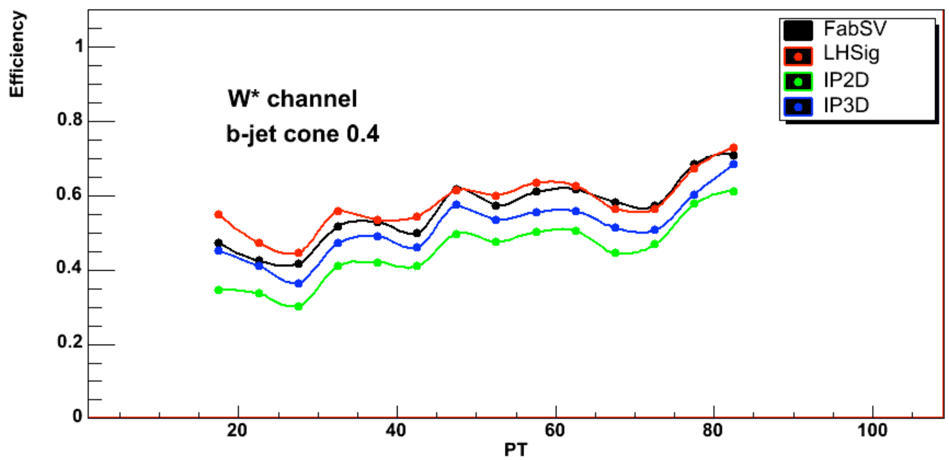
- Number of jets : N(jet) = 2
- Presence of two high p_T jets
- Presence of two central, high-p_T b-tagged jets
- Reconstruct $M_{l\nu b}$ within $m_{top} \pm 25$ GeV/c^2
- Window in H_T

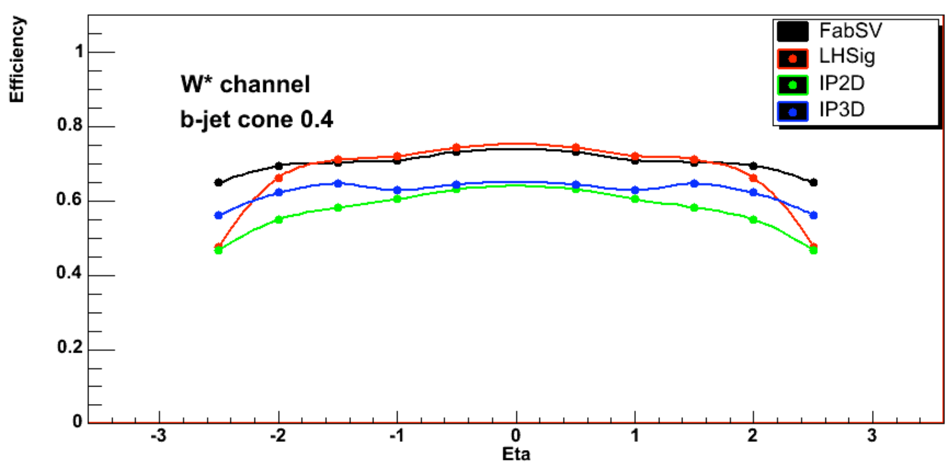
2 bjets only

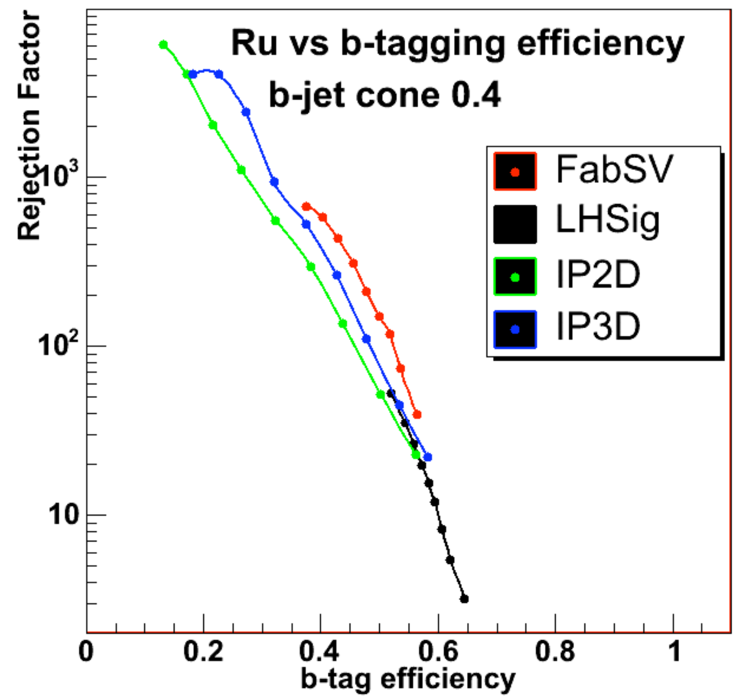


One high pt ele (Et > 20)	40%
+ one b-jet > 50	38%
+one ele + 2 jets (1 tagged)	19%
+one more b-jet > 25	4%

s-channel

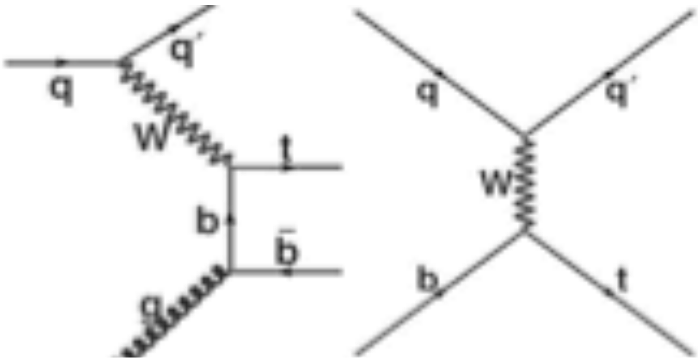






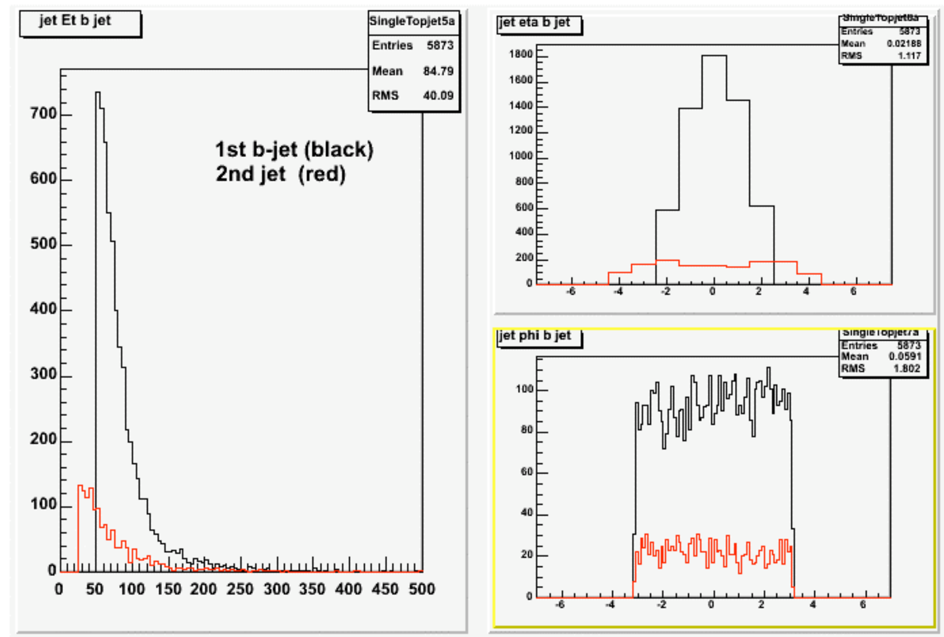
Highets E_T bjet used for Studies - small statistics

Wg channel



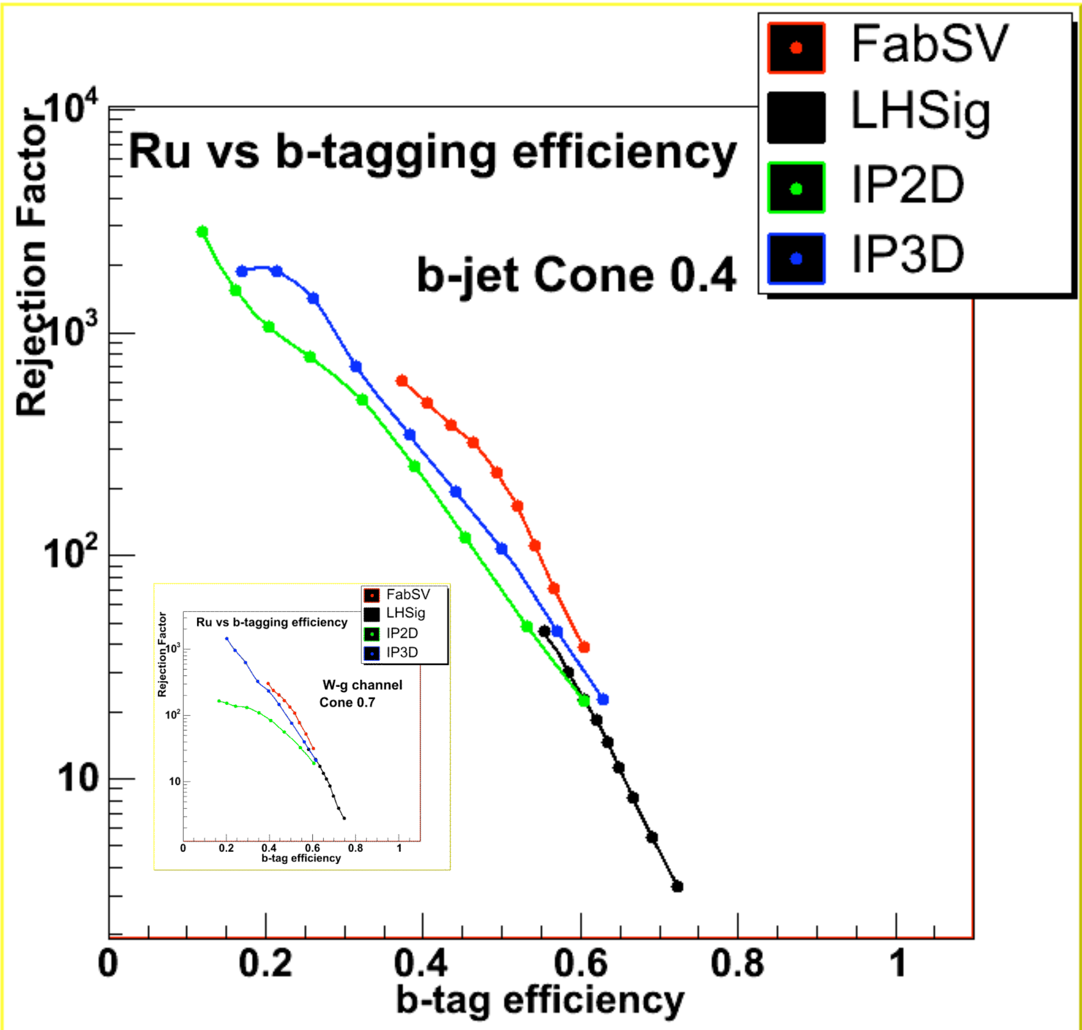
Selection criteria

- Number of jets : N(jet) = 2
- Presence of a high-p_T b-tagged jets (p_T>40GeV/c)
  Wg evts have 1 b-jet escaping the acceptance
  → requires **only** 1 b-tagged jet
- Presence of a high-p_T forward jet
  → 1 jet with $|\eta|$>2.5 and $p_T \geq$ 50GeV/c
- Reconstruct $M_{l\nu b}$ within ±25 GeV/c^2
- Window in H_T

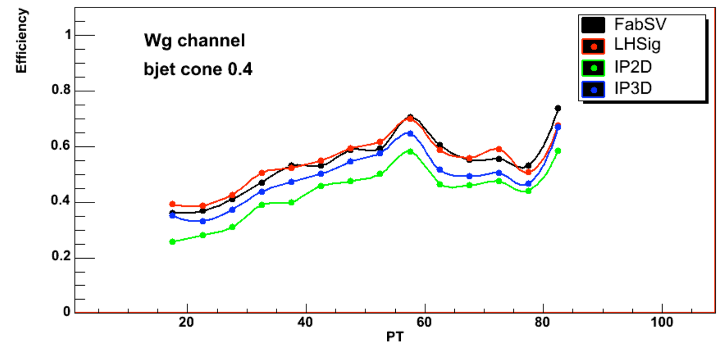


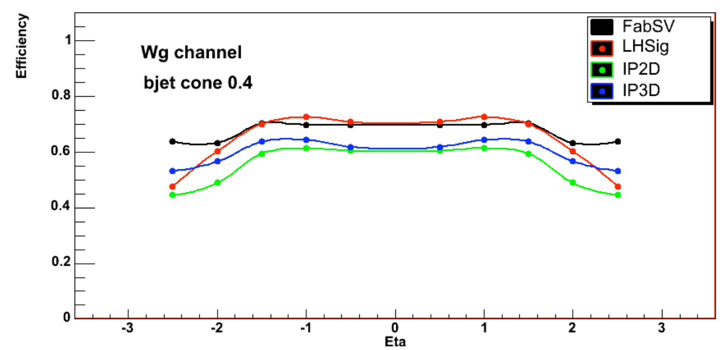
One high pt ele	41%
+ one b-jet > 50	28%
+ 1 more jet > 30	6.7%

Wg channel



Highets E_T bjet used for Studies - small statistics

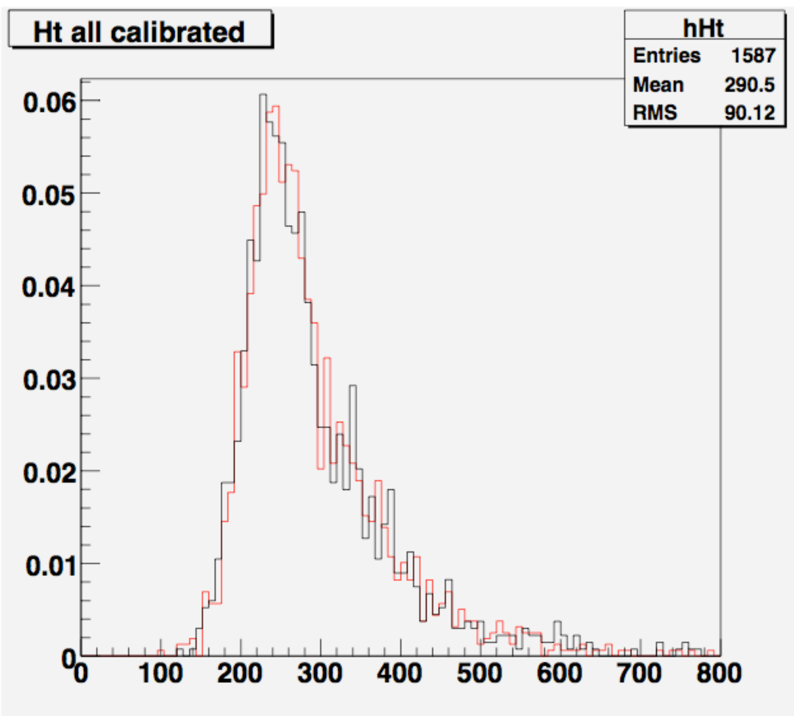




Jet Resolution

Jet Resolution Studies (atlfast)

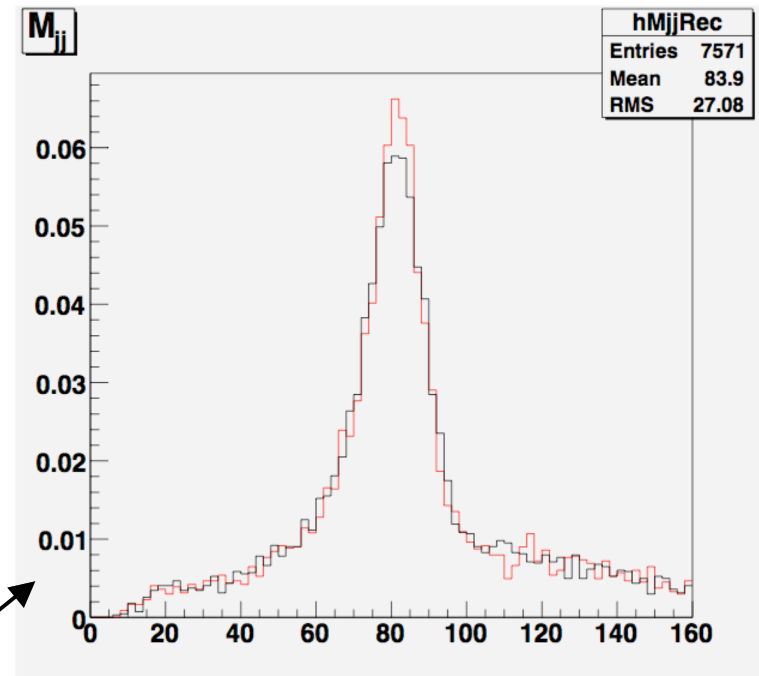
H_T distribution obtained when switching on and off the energy smearing due to the calorimeter resolution (*DoSmearing* flag)



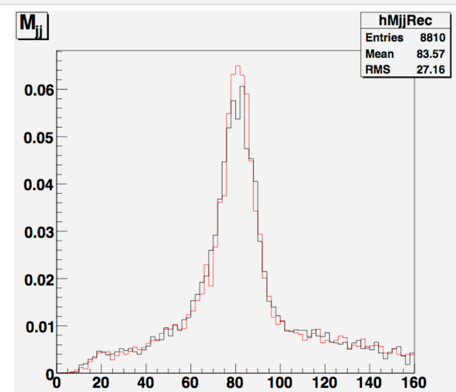
Ht distribution with standard selection cuts with (black) and without smearing (red) for 0.7 cone size on full available statistics of Wt events.

Jet Resolution Studies (atlfast)

The width of the distribution seems dominated by the smearing due the jet reconstruction algorithm as it also seems from looking at the effect of the smearing on of on the jet jet invariant mass.



Here are the plots for the jet jet reconstructed mass for 0.7 and 0.4 cone size.



Conclusions on Single Top

ATL-COM-PHYS-2006-036

- <u>B-Tag studies on Wt samples</u>:
  - Preliminary tests on various b-tag algorithms, as out of the box on Rome samples for single top were performed
  - Generally good agreement with previous studies (L.V.)
  - LHSig seems the most powerful flag to use to select b-jets (LHSig > 0.9) in Wt data but it is necessary to control the light jet rejection rate
- <u>Calorimeter Smearing Studies</u>:
  - No visible effects, major effect coming from jet algorithms
- <u>Future Activities</u>:
  - DC3 samples almost ready, background estimates and complete analysis
  - CSC note on Single Top: co-editor

CSC Notes

The CSC notes are to be produced by the Physics and joint performance group using data made for the Computing System Commissioning

~100 Notes, 1 or 2 editors each: ~150 people/2000

- Standard Model
  - Jets and Min Bias (Buttar, Moraes)
  - W/Z cross section (Boonekamp, Di Ciaccio)
  - W mass (Peterson)
  - Asymmetry in Z (Aharrouche)
  - W/Z+jets (Huston)
  - Dibosons (Zhou)
  - PDF's (Cooper-Sarkar)
  - Gamma+jet (TBD)
- Top
  - T1 Leptons (Pralavorio)
  - T2 light jets (Schwindling)
  - T3 B jets (Hawkings)
  - T5 Trigger (Wengler)
  - T6 Cross section (Bentvelsen, Cobal)
  - T7 Top properties (Onofre, Tokar)
  - T8 Single top (A. Lucotte, S. Rolli)
  - T9 Mass (Pallin, Etienvre)

. ..

- Higgs
  - HG1 (Carminati, Mellado)
  - HG2 (Paganis, Nisati)
  - HG3 (Cranmer, Tsuno)
- Exotics
  - Black Holes (Parker, Issever)
  - Dibosons (Azuelos)
  - Lepton+jets (Savinov, Strohmer)
  - Dileptons (Black, Ferrag)
  - Leptons+ etmiss (Flores)
- SUSY
  - SUSY1 (Asai) : Data-driven Estimation of Z/W backgrounds to SUSY
  - SUSY2 (De Jong): Data-driven Estimation of top Backgrounds to SUSY
  - SUSY3 (Tovey): Data-driven Estimation of QCD Backgrounds to SUSY
- BPhysics
  - Dimuon Triggers for B-physics (Kanaya)
  - Single Muon trigger for B-physics (Tarem)
  - Muons from K/pi in B-events (Di Mattia)
  - Muons+ Calormimeter trigger for B-decays (Baines)
  - B to mumu and backgrounds (Nikitine, Sivoklokov)
  - Rare semi leptonic decays (Reznicek)
  - Trigger efficiency (Kono)
  - Cross Sections (Zur Nedden)
  - Onia (Kartvelishvili)
  - J/psi to ee : b-triggers, offline reconstruction and calibrations (Derue)
  - B to psi K+ (Petridou)
  - B to psi K0, psi phi (Smizanska)
  - B to psi Lambda (Neal)
  - Triggers for hadronic decays (Epp, Walkowiak)
  - Chib (Gazis)

CSC Note on Single Top

Conclusions on ATLAS work

The <u>analysis framework</u> is well developed in ATLAS

Tools are well advanced and easy to use

The <u>analysis ability</u> is still very much in its infancy:

many people with LEP experience

TeVatron people starting working actively

It is important to step in now and contribute with experience from the TeVatron

Still the collaboration is oversubscribed….it will be interesting to observe what happens in 2008!

Talks and Presentations

- Simona Rolli, I.F.A.E., Pavia April 2006
  - Recent Results on Searches for BSM Physics at the TeVatron
  - Single Top at Hadron Colliders

- Simona Rolli, ATLAS Workshop on SM Physics, Argonne April 2006
  - Single Top Wt Channel Studies

- Simona Rolli, Third North American ATLAS Physics Workshop, Boston July 2006
  - Btagging Perfomance Studies

- Simona Rolli, PASCOS 06, Ohio State University, September 2006
  - Top Physics at LHC